

GFE Job Sheet 1 : Getting Started

Objective

This job sheet will familiarize the user with GFE.

Procedures

A. Starting the Graphical Forecast Editor (GFE) on the GFE Development Workstation.

1. Log into the Linux PC as user gfe.
2. Close out of the “start here” file manager if it pops up.
3. Ensure the GFE server program is running by double clicking on the *Start GFE Server* icon. A message should pop up in the center of the screen telling you that the GFE server has been started.
4. Start the GFE program by clicking on the *GFE (user = VEF)* icon. The various areas of the GFE display are identified below. Take a moment to familiarize yourself with the appearance of the GFE display before continuing.

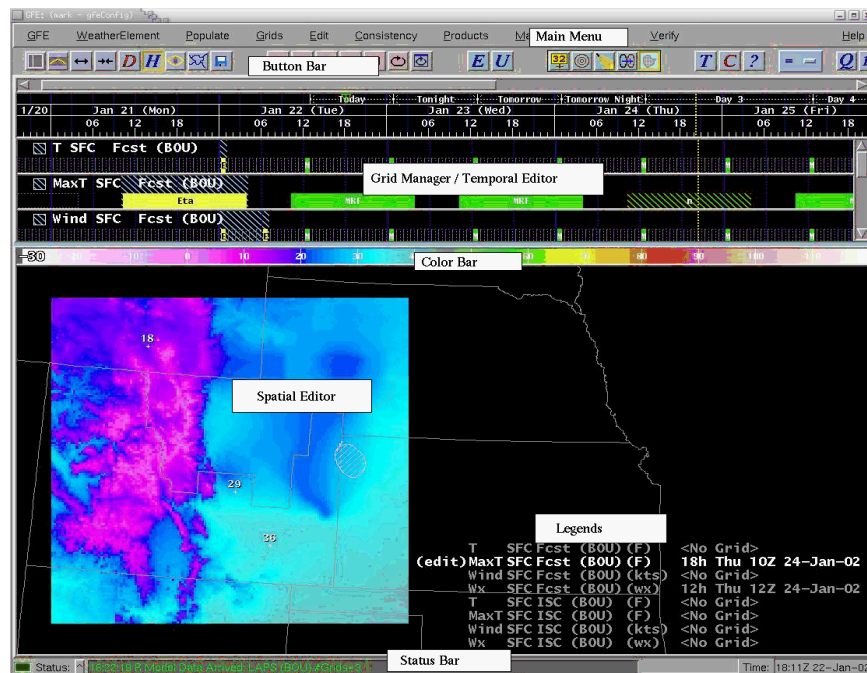


Figure 1A. GFE with Grid Manager on Top

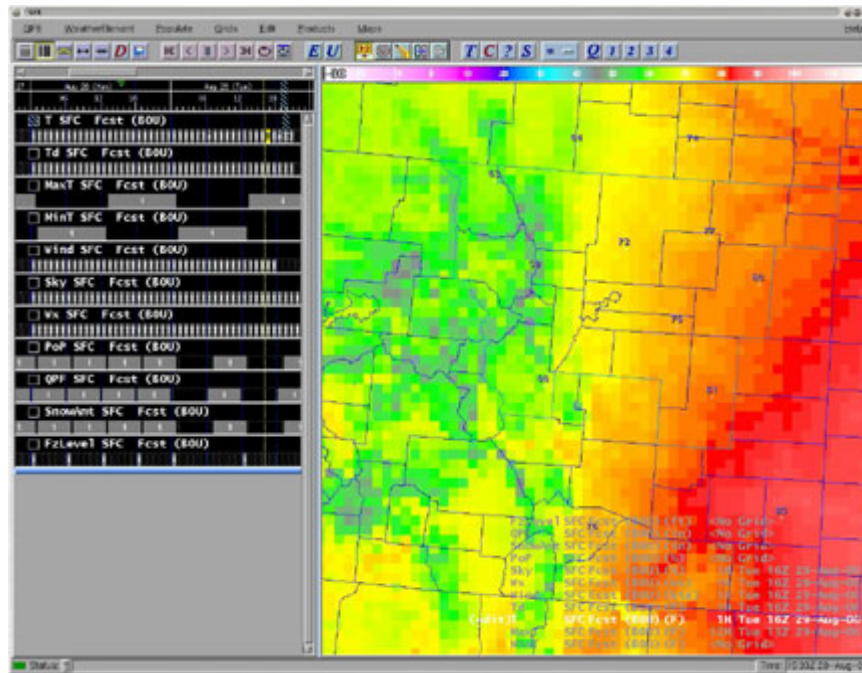


Figure 1B. GFE with Grid Manager on Side

NOTE: This section has been taken directly from the online help. The online help for GFE is excellent and you will use it extensively to learn the software. To access the online help, click on the “help” pull down menu on the top right of the GFE display.

The following material written by Thomas LeFebvre should give you a good overall introduction to GFE.

A. Introduction

The Graphical Forecast Editor (GFE) is the tool with which forecasters modify digital data that defines the future state of the atmosphere. These digital datasets take the form of grids – regularly spaced values defined continuously over a particular domain. The GFE comprises three separate editors, each with a different view of the digital data. The Grid Manager presents a database inventory, allows users to populate the forecast with gridded data derived from numerical models, interpolates gaps in the forecast based on grids already defined, and adjusts the time period over which each forecast grid is valid. The Spatial Editor displays forecast grids in plan (map) view format and offers a variety of tools with which forecasters manipulate gridded data values. The Temporal Editor displays the digital data in a time-series format over an area selected by the forecaster. Using the Temporal Editor tools, forecasters can modify the time-series display which is then applied to the gridded data. All three editors are linked together by the 3-dimensional digital database (Refer to Figure 1A & B).

B. Grid Manager

Figure 2 displays the Grid Manager user interface. The display presents the user with an inventory of the gridded database. Each light gray rectangle represents a single grid of values for some type of forecast weather element. The length and position of each block graphically displays the time period over which the particular grid is valid. The timescale, located at the top, provides a time reference.

Typically, forecasters begin to shape their forecast using the Grid Manager. It offers a variety of tools to define the general state of the atmosphere, including populate from numerical models, interpolate, and time adjustment. Once the general outline of the forecast is defined with the Grid Manager, forecasters move to other editors to further refine the forecast.

Populate – During the first portion of a forecast shift, a typical forecaster spends time getting briefed by colleagues and reviewing meteorological observations and Numerical Weather Prediction (NWP) models. This process offers time for the forecaster to formulate an opinion about whether a particular model seems to have a more accurate view of the future state of the atmosphere than the current forecast. If the forecaster is deciding to initialize the digital forecast from a model, the GFE allows him/her to copy sets of weather elements directly into the forecast. This process we call populate, since forecasters are populating their forecast with grids of weather elements from a model source. Currently forecasters may choose from all the major synoptic numerical models (Eta, AVN, NGM, MRF), models run at the local office, and observational grids derived from a surface analysis package.

Interpolate – Once the forecast is defined at 3 or 6-hour intervals, time gaps in the forecast can be filled using the interpolate facility. Using the Grid Manager, forecasters select the weather elements and time period over which they want to interpolate. A spline algorithm calculates values at times between the defined values, resulting in a smooth temporal curve at each grid point. The interpolate facility also attempts to advect discrete fields across the forecast area for weather elements, such as precipitation and obstructions to vision. Using interpolate, forecasters fill in a forecast defined only every 3 or 6 hours into a forecast that is defined each hour.

Time Period Adjustment – Some weather elements such as precipitation, visibility, and clouds may change little for many consecutive hours. The Grid Manager offers tools that allow the forecasters to quickly adjust the time period over which any grid is valid. Using the middle mouse button, users drag the edge of any forecast grid to adjust its time period.

Other Tools – In addition to the tools mentioned above, the GFE offers other operations such as Delete, Copy, Paste, and Time Shift that let forecasters arrange the forecast grids in time. These tools work similar to word processing programs in that one selects the grid on which to operate and then chooses the operation. The "Create Grid from Scratch" option allows forecasters to create a new grid defined with the same value everywhere.

Procedures – Many times forecasters will repeat various sequences of commands during an edit

session. Procedures were implemented to make issuing a repeated sequence of commands simple and easy. Once a particular procedure is set up, users need only to invoke a single command and potentially dozens of operations will be executed. Currently procedures may populate, interpolate, remove grids, create grids from scratch, assign a default value, and time shift grids. These capabilities will be enhanced in future versions of the GFE.

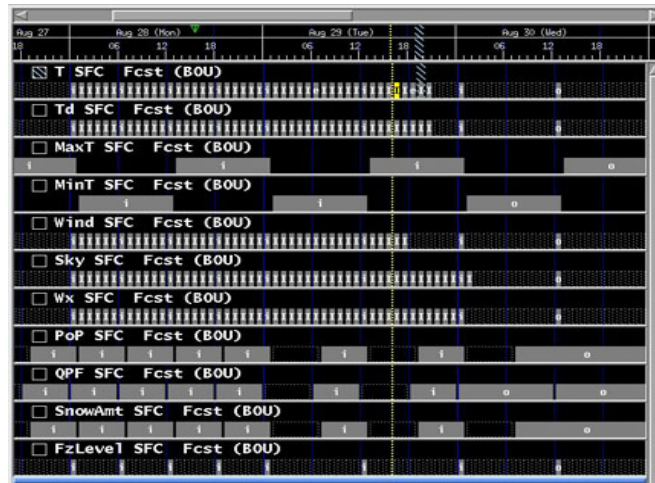


Figure 2. GFESuite Grid Manager user interface.

C. Spatial Editor

Once the general forecast has been populated in the Grid Manager, the forecaster views the grids in the Spatial Editor. Figure 3 shows the layout of the Spatial Editor as it displays a single grid of temperature in a plan view. Since users of the Graphical Forecast Editor are also users of the AWIPS D2D (Display Two Dimensional) system, we have designed the interface to the Spatial Editor to behave like D2D as much as possible.

The Spatial Editor can be animated to display forecast grids in sequence. Animation buttons located near the top of the GFE window look and behave almost identically to the D2D animation buttons. Within the SE Display, legends at the bottom indicate the weather element name and the time over which the currently viewed grid is valid. Users may toggle the display of any weather element with one mouse click or by using the keypad, just like D2D.

The Spatial Editor also offers many tools with which forecasters manipulate the values of the gridded data. To execute an edit operation, a forecaster selects the area to edit and then executes any operation of his or her choice. The basic operations are assign a value, adjust values (up or down), and smooth values. Each operation is executed over the set of grid points selected in the Spatial Editor. Other, more interactive tools are available as well. The Contour and Pencil Tools allow users to adjust the value and position of contours and then calculate a new grid based on the edited contours. The Move/Copy tool moves or copies a selected region of data to a new location.

D. Spatial Editor Tools

Developing a set of effective tools is critical for any editing system. This challenge was especially difficult since the GFESuite software is expected to work in climate regimes as disparate as those found in Florida and Alaska. After several prototypes and copious input from operational forecasters, the GFE tools have evolved into two categories. When initially installed by the forecaster, the GFE will offer about a dozen built-in tools that modify gridded forecast data. In addition, the GFE includes a framework with which forecasters can invent their own tools and operations. The Smart Tools framework allows the local office to compose their own tools to better handle the weather expected for their climate.

Contour Tool – While the GFE is fundamentally a grid-based system, the Contour tool allows forecasters to view and edit the data in terms of sets of contours rather than gridded data. When the Contour tool is selected, a set of editable contours is drawn on top of the gridded values. Users may perform a number of operations on these contours, such as create or draw a new contour and delete or adjust an existing contour. When forecasters finish modifying the contours, they select "Calculate New Grid" from a pop-up menu. An algorithm calculates a new gridded field based on the positions and values of the contours.

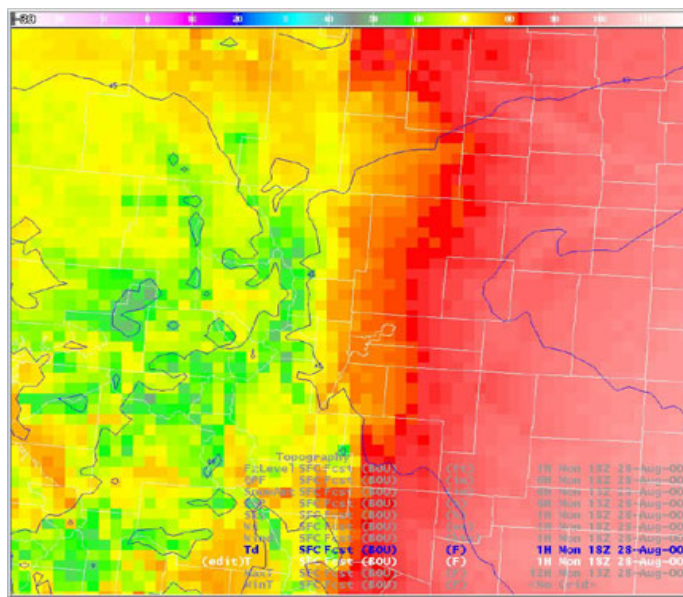


Figure 3. Spatial Editor displays a single grid of temperature in the plan view.

Pencil Tool – The Pencil tool behaves like a contour adjustment tool, but is in fact a grid-based tool. To operate it, the mouse is used to drag a new position of a pseudo or virtual contour. Each grid point along the new path is assigned the value at the initial press point. All other grid points within a defined distance of the path are spatially interpolated using a distance-weighted scheme. The result is a gridded field that has been adjusted as if a contour at the beginning of the operation were moved. With time, we expect that the Pencil tool will be integrated with the

Contour tool, since they function so similarly.

Sample Tool – This tool displays an alpha-numeric readout of the grid values that lie directly under the cursor. No data can be modified when using the Sample tool. Users may sample values interactively by moving the cursor or "anchor" samples to always display values at any location.

Define Area Tools – The next set of tools operates over an area defined by the user. To use these types of tools, the user must first define a region over which a tool will operate. There are two ways to define these regions called Edit Areas: the Define Area tool and Edit Area Queries.

The Define Area tool lets the forecasters define an Edit Area graphically by drawing a polygon on the Spatial Editor display. The area inside the polygon is shaded, indicating that all points inside the polygon are selected for edit. Once the user is satisfied with the Edit Area, an edit operation is applied to all of the grid points that lie inside the edit area.

Edit Area Queries – This feature is used to define Edit Areas based on the values of the underlying gridded data. For example, if a forecaster executed the query "T > 75," all of the grid points whose value is greater than 75 will be selected as part of the edit area. Edit Area Queries help facilitate a more meteorological approach to grid editing than the tools discussed thus far. The ability to operate on grid points based on their value lets forecasters better concentrate on the meteorology, while freeing them from some of the tedious drawing operations that can be cumbersome. Queries are not limited to the simple example above; they can be very complex, encompassing many forecast weather elements. Once composed, queries can be saved for later use.

Edit Actions – Edit Actions are those operations that forecasters apply to the current Edit Area. Some Edit Actions are simple such as assign a new value while others can be quite complex as calculate the enhanced field precipitation due to terrain and winds. The GFE comes with the built-in Edit Actions Assign, Adjust (Up/Down), and Smooth. However, users are encouraged to use the Smart Tool framework to develop their own tools for implementing meteorological concepts.

While specific algorithms may vary, the way users execute Edit Actions is the same. First, forecasters select the area over which the edit operation is to be executed. Optionally, forecasters may choose a time period over which the tool will operate to include many grids in the edit operation. Finally, when the particular Edit Action is chosen, the specific algorithm executes over each selected grid point in each selected grid. For example, forecasters decide that the current temperature field is 5 degrees too warm in the mountains. First, all grid points that are over 8,000 feet elevation are selected via a query. Next, the delta value is changed to 5 degrees. Finally, the Edit Action "Adjust Down" is selected and it subtracts 5 degrees from each grid point that was selected earlier (points above 8,000 feet elevation).

While interactive tools, such as the Contour tool, work well for many forecasters, they have disadvantages. Their interactive nature requires an inordinate amount of time dedicated to design and implementation, and also that much emphasis be placed on their speed. In contrast, Edit

Actions simply operate on gridded data, and they are easy to learn and simple to use. They can also be modified at the local office in order to better capture the local meteorology.

Smart Tools – Earlier we stated that when we developed the original set of tools for the GFE, we knew that they alone would never suffice. Experience with the GFE has shown that many forecasters had a difficult time keeping all weather elements consistent with each other, particularly during complex weather scenarios. New tools needed to be developed that were "meteorologically aware" so that forecasters could modify the digital data in special ways and also keep weather elements consistent in the process. We also know that since the best source of meteorological expertise resides at the local office, the tools must be highly tailorable. The solution was to engineer a framework within which forecasters create and modify their own tools. The Smart Tools framework allows forecasters to create small pieces of software that modify the forecast data in a way that is consistent with laws of atmospheric physics and other forecast weather elements. For example, a forecaster knows that in places where the temperature and the dewpoint are nearly the same value, fog is likely to form. The forecaster can write a tool that calculates the difference between the temperature and the dewpoint and assign fog to those places where the difference is small.

This simple example illustrates the advantages of using Smart Tools. The forecast is modified in a way that is consistent with other weather elements of the forecast, producing a forecast grid with unprecedented detail. It would simply take too much time for forecasters to attempt to create a grid with this type of detail by hand. Most important, forecasters now have a framework with which they can express a precise meteorological concept, and then let the editing system do the tedious work of defining data values at each grid point.

E. Temporal Editor

The Temporal Editor (Figure 4) presents a time-series view of the gridded data over the area selected in the Spatial Editor. Each gridded value inside the selected area is averaged to a single value and graphically displayed in the Temporal Editor. This display allows forecasters to view temporal trends in the forecast at any point or area desired. However, as its name implies, the Temporal Editor is not just a viewer. Users can modify the graphical time-series display and hence, modify the underlying gridded data on which it is based. For example, if a user changes a temperature time-series dataset such that the new values are 5 degrees warmer, 5 degrees will be added to each grid point inside the selected area. Similarly lowering values in the time series display causes all of the values in the selected grid to be decreased by the same amount. Since many grids can be displayed simultaneously in the Temporal Editor, forecasters can edit a large number of grid points with a single edit operation.

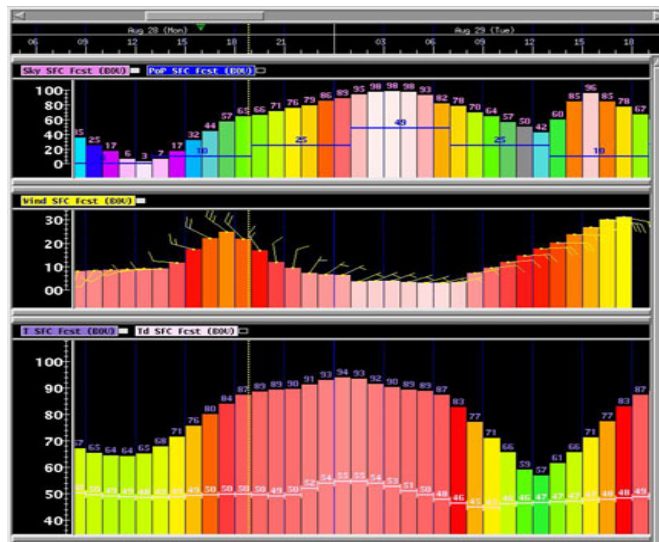


Figure 4. Temporal Editor showing a time-series view of the gridded data over an area.

For data types that are discrete, such as weather and obstructions to vision, the Temporal Editor allows users to assign a value to the time series and again to all of the selected grid points in the Spatial Editor.

Summary

Building the infrastructure that supports the grid-based editor took several years of software design and development work. Now that it is complete, we are free to focus on tools that manipulate the digital forecast data similar to the way forecasters think. The addition of our Smart Tools framework now makes the GFE a truly open-ended system on which forecasters can develop their own forecast techniques. The developers will continue to add new functionality, but much of the innovation will occur at the forecast office.

For more than 30 years, the NWS has delivered the forecast in worded form. As a result, the concept of expressing the forecast as gridded digital weather elements is very foreign to forecasters. Once they learn the system, forecasters will be able to better focus on the meteorology, rather than the text. When the forecast is expressed digitally, a wide array of graphical products can be easily generated that can express the forecast to consumers more clearly and also offer more detail than was possible when only words were used to convey the forecast. This paradigm thus allows forecasters to think more in meteorological terms and ultimately provide better weather services to their customers.